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(ORPeeR
TMS 12/7/04)

A thermopneumatic *micropump* based on micro-engineering techniques.

USPTO Full Text Retrieval Options

Accession number & update

3715860, B90061675; 900000.

Author(s)

Van-de-Pol-F-C-M; Van-Lintel-H-T-G; Elwenspoek-M; Fluitman-J-H-J.

Author affiliation

Dept of Electr Eng, Twente Univ, Enschede, Netherlands.

Source

5th International Conference on Solid-State *Sensors* and *Actuators* and Eurosensors III, Montreux, Switzerland, 25-30 June 1989.

Sponsors: Swiss Soc. Sensor Technol., IEEE.

In: *Sensors-and-Actuators-A* (Physical)(Switzerland), vol.A21, no.1-3, p.198-202, Feb. 1990.

ISSN

ISSN: 0924-4247, CCCC: 0924-4247/90/ (\$3.50).

Publication year

1990.

Language

EN.

Publication type

CPP Conference Paper, J Journal Paper.

Treatment codes

P Practical; X Experimental.

Abstract

The design, working principle and realization of an electro-thermopneumatic liquid pump based on micro-engineering techniques are described. The pump, which is of the reciprocating displacement type, comprises a pump chamber, a thin silicon pump membrane and two silicon check valves to direct the flow. The dynamic pressure of an amount of gas contained in a cavity, controlled by resistive heating, actuates the pump membrane. The cavity, chambers, channels and valves are realized in silicon wafers by wet chemical etching. Experimental results are presented. Maximum yield and built-up pressure equal 34 mu l/min and 0.05 atm. at a supply voltage of 6 V. Results of simulations show good agreement with the actual dynamic behaviour of the pump. (7 refs).

Descriptors

electric-actuators; etching; integrated-circuit-technology; pumps; semiconductor-technology; valves.

Keywords

Si valves; pneumatic relaxation; hydraulic relaxation; thermopneumatic *micropump*; micro engineering; electro thermopneumatic liquid pump; reciprocating displacement; dynamic pressure; resistive heating; wet chemical etching; Si membrane.

Classification codes

B2560Z (Other semiconductor devices).

B2550E (Surface treatment and oxide film formation).

Chemical indexing

Si int, Si el.

INSPEC SEARCH STRATEGY

Search strategy

- No. 1, Database INZZ; Search term: "sensors and actuators.SO." (Info added since: unrestricted, Results 13363)
- No. 2, Database INZZ; Search term: "(van lintel-\$ ADJ -H\$).AU." (Info added since: unrestricted, Results 9)
- No. 3, Database INZZ; Search term: "von lintel ADJ -h\$" (Info added since: unrestricted, Results 12397)
- No. 4, Database INZZ; Search term: "(von-\$ ADJ lintel-\$ ADJ -H\$).AU." (Info added since: unrestricted, Results 0)
- No. 5, Database INZZ; Search term: "(von lintel-\$ ADJ -h\$).AU." (Info added since: unrestricted, Results 0)
- No. 6, Database INZZ; Search term: "MICROPUMP-\$.ID. OR MICROVALVE-\$.ID." (Info added since: 1990, Results 0)
- No. 7, Database INZZ; Search term: "MICROPUMP.ID. OR MICROVALVE.ID." (Info added since: unrestricted, Results 622)
- No. 8, Database INZZ; Search term: "1 AND 7" (Info added since: unrestricted, Results 142)

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(B)

Accession number & update

3776066, B90079652, C91001661; 910100.

Title

A micro chemical analyzing system integrated on a silicon wafer.

Author(s)

Nakagawa-S; Shoji-S; Esashi-M.

Author affiliation

Dept of Electron Eng, Tohoku Univ, Sendai, Japan.

Source

Proceedings. IEEE Micro Electro Mechanical Systems. An Investigation of Micro Structures, Sensors, Actuators, Machines and Robots (Cat. No.90CH2832-4), Napa Valley, CA, USA, 11-14 Feb. 1990, p.89-94.

Sponsors: IEEE.

Published: IEEE, New York, NY, USA, 1990, xiii+226 pp.

ISSN

CCCC: CH2832-4/90/0000-0089 (\$01.00).

Publication year

1990.

Language

EN.

Publication type

CPP Conference Paper.

Treatment codes

A Application; P Practical; X Experimental.

Abstract

The fabrication of a three-way valve on a silicon wafer by micromachining techniques is presented. The valve consists of two silicon wafers, a pyrex glass, and a piezoelectric actuator. This three-way valve can control gas flow or liquid flow with voltage applied to the actuator. The liquid flow can be controlled from 0.1 μ l/min to 70 μ l/min. The results from integrating the three-way valve with a micropump to produce a flow injection analyzing system are discussed. (4 refs).

Descriptors

electric-actuators; elemental-semiconductors; flow-measurement; silicon; valves.

Keywords

three way valve; micromachining techniques; piezoelectric actuator; gas flow; liquid flow; micropump; flow injection analyzing system; Si.

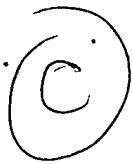
Classification codes

B7320W (Level, flow and volume).

C3260B (Electric equipment).

Chemical indexing

Si sur, Si el.

**Fulltext Links**[USPTO Full Text Retrieval Options](#)**Accession number & update**

5813922, B9803-2575-008, C9803-3260B-003; 980129.

TitleValve-less diffuser micropumps fabricated using **thermoplastic replication**.**Author(s)**

Olsson-A; Larsson-O; Holm-J; Lundblath-L; Ohman-O; Stemme-G.

Author affiliation

Dept of Signals, Sensors & Syst, R Inst of Technol, Stockholm, Sweden.

SourceIEEE Tenth Annual International Workshop on Micro Electro Mechanical Systems. An Investigation of Micro Structures, **Sensors, Actuators**, Machines and Robots, Nagoya, Japan, 26-30 Jan. 1997.

Sponsors: IEEE Robotics & Autom. Soc., ASME Dynamic Syst. & Control Div., Micromachine Center.

In: **Sensors-and-Actuators-A (Physical)**(Switzerland), vol.A64, no.1, p.63-8, 1 Jan. 1998.**CODEN**

SAAPEB.

ISSN

ISSN: 0924-4247, CCCC: 0924-4247/98/ (\$19.00).

Availability

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Electronic Journal Document Number: S0924-4247(97)01655-5.

Publication year

1998.

Language

EN.

Publication type

CPP Conference Paper, J Journal Paper.

Treatment codes

P Practical; X Experimental.

Abstract

This paper presents valve-less diffuser micropumps fabricated using **thermoplastic replication**. **Thermoplastic replication** is very suitable for a valve-less diffuser pump due to its simple planar geometry. Two different **thermoplastic replication** methods have been tested: hot embossing and injection molding. We use 0.1 and 0.2 mm deep precision-milled brass mold inserts and 20 and 80 μ m deep microelectroformed nickel mold inserts defined from deep reactive ion etched (DRIE) silicon wafers. For the injection molding a commercially available compact disc injection-molding machine (Toolex Alpha MD100) is used to fabricate the diffuser micropumps. The cycle times are extremely short, less than 10 s per disc, and one properly fabricated nickel mold insert can be used to fabricate more than 10000 plastic discs. The plastic material cost is about 5 cents per disc. Tested pumps reach a maximum volume flow of 1.2 ml min⁻¹ and a maximum pump pressure of 16 kPa. (11 refs).

Descriptors

diaphragms; electroforming; flow-control; micromachining; micropumps; replic-

Keywordsvalve less diffuser micropumps; **thermoplastic replication**; fabrication; simple planar geometry; hot embossing; injection molding; precision milled brass mold inserts;

microelectroformed Ni mold inserts; deep reactive ion etched wafers; short cycle time; MEMS; micromachining; diaphragm motion; 0.1 mm; 0.2 mm; 20 micron; 80 micron; 16 kPa; Si; Ni.

Classification codes

B2575 (Micromechanical device technology).
B8380 (Control gear and apparatus).
C3260B (Electric actuators and final control equipment).
C3120T (Level, flow and volume control).

Chemical indexing

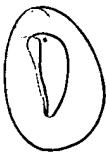
Si sur, Si el; Ni sur, Ni el.

Numerical indexing

pressure: 1.6E+04 Pa;
size: 1.0E-04 m, 2.0E-04 m, 2.0E-05 m, 8.0E-05 m.

Copyright statement

Copyright 1998, IEE.

**Accession number & update**

5651099, B9709-2575-033; 970729.

Title

Valve-less diffuser micropumps fabricated using **thermoplastic** replication.

Author(s)

Olsson-A; Larsson-O; Holm-J; Lundbladh-L; Ohman-O; Stemme-G.

Author affiliation

Dept of Signals, **Sensors & Syst**, R Inst of Technol, Stockholm, Sweden.

Source

Proceedings IEEE The Tenth Annual International Workshop on Micro Electro Mechanical Systems. An Investigation of Micro Structures, **Sensors, Actuators, Machines and Robots**, Nagoya, Japan, 26-30 Jan. 1997.

Sponsors: IEEE Robotics & Autom. Soc., ASME Dynamic Syst. & Control Div., Micromachine Center.

In: p.305-10, 1997.

ISSN

ISBN: 0-7803-3744-1, CCCC: 0 7803 3744 1/97/ (\$5.00).

Publication year

1997.

Language

EN.

Publication type

CPP Conference Paper.

Treatment codes

P Practical; X Experimental.

Abstract

Here we present the first valve-less diffuser micropumps fabricated using **thermoplastic** replication. Due to its simple planar geometry the valve-less diffuser pump is very suitable for **thermoplastic** replication. Two different **thermoplastic** replication methods have been used: hot embossing and injection molding. As mold inserts we used 0.1 and 0.2 mm deep precision milled brass mold inserts and 20 and 80 μm deep microelectroformed nickel mold inserts defined from deep reactive ion etched (DRIE) silicon wafers. For the injection molding a commercially available Compact Disc injection molding machine (Toolex Alpha MD100) was used to fabricate the diffuser micropumps with extremely short cycle times. One properly fabricated mold insert of nickel can be used to fabricate more than 10000 plastic discs with a cycle time of less than 10 seconds per disc. The plastic material cost is about 5 cents each. Tested pumps reached a maximum volume flow of 1.9 ml/min and a maximum pump pressure of 7.7 kPa. (10 refs).

Descriptors

elemental-semiconductors; micropumps; nickel; silicon.

Keywords

valve less diffuser micropumps; **thermoplastic** replication; planar geometry, hot embossing; injection molding; Ni deep microelectroformed mold; deep reactive ion etching; Si wafers; Toolex Alpha MD100; plastic discs; 0.1 to 0.2 mm; 20 μm ; 80 μm ; 7.7 kPa; Si.

Classification codes

B2575 (Micromechanical device technology).

Chemical indexing

Si sur, Si el.

Numerical indexing

pressure: 7.7E+03 Pa;

size: 1.0E-04 to 2.0E-04 m, 2.0E-05 m, 8.0E-05 m.

Copyright statement

Copyright 1997, IEE.

Search strategy

- No. 1, Database INZZ; Search term: "sensors and actuators.SO." (Info added since: unrestricted, Results 13363)
- No. 2, Database INZZ; Search term: "(van lintel-\$ ADJ -H\$).AU." (Info added since: unrestricted, Results 9)
- No. 3, Database INZZ; Search term: "von lintel ADJ -h\$" (Info added since: unrestricted, Results 12397)
- No. 4, Database INZZ; Search term: "(von-\$ ADJ lintel-\$ ADJ -H\$).AU." (Info added since: unrestricted, Results 0)
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- No. 7, Database INZZ; Search term: "MICROPUMP.ID. OR MICROVALVE.ID." (Info added since: unrestricted, Results 622)
- No. 8, Database INZZ; Search term: "1 AND 7" (Info added since: unrestricted, Results 142)
- No. 9, Database INZZ; Search term: "thermoplastic.TI." (Info added since: unrestricted, Results 1513)
- No. 10, Database INZZ; Search term: "microengineering.TI." (Info added since: unrestricted, Results 56)
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- No. 12, Database INZZ; Search term: "9 AND 10" (Info added since: unrestricted, Results 0)
- No. 13, Database INZZ; Search term: "9 AND 1" (Info added since: unrestricted, Results 5)

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